

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

A-level PHYSICS

Paper 3

Section B Astrophysics

Friday 5 June 2020

Afternoon

Time allowed: The total time for both sections of this paper is 2 hours. You are advised to spend approximately 50 minutes on this section.

Materials

For this paper you must have:

- a pencil and a ruler
- a scientific calculator
- a Data and Formulae Booklet.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 35.
- You are expected to use a scientific calculator where appropriate.
- A Data and Formulae Booklet is provided as a loose insert.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
TOTAL	



Section BAnswer **all** questions in this section.**0 1 . 1**

Draw a ray diagram for a Cassegrain telescope.
Your diagram should show the paths of **two** rays up to the eyepiece lens.
The rays should initially be parallel to the principal axis.

[2 marks]

_____ principal
axis

0 1 . 2

A spacecraft passes Pluto at a distance of 12 500 km. The telescope on board has an aperture of diameter 0.21 m and operates at a wavelength of 450 nm.

Discuss whether this telescope is suitable for studying a crater with a diameter of approximately 1 km on Pluto.

[3 marks]



0 1 . 3

The Hubble telescope has an aperture of diameter 2.4 m.

Compare the collecting power of the Hubble telescope with the telescope on the spacecraft in Question 01.2.

[2 marks]

0 1 . 4

An astrophysicist had to decide whether to use a reflecting telescope or a refracting telescope on the spacecraft in Question 01.2.

Discuss which type of telescope to use.

[3 marks]

10

Turn over ►



0 2

Table 1 summarises some information about four stars in the constellation Cassiopeia.

Table 1

Name	Colour	Apparent magnitude	Distance / ly
Caph	white	2.3	55
Ruchbah	blue/white	2.7	99
Schedar	orange	2.2	228
Tsih	blue	2.2	610

0 2

. 1

Which star has the highest surface temperature?

Tick (✓) **one** box.

[1 mark]

Caph

Ruchbah

Schedar

Tsih

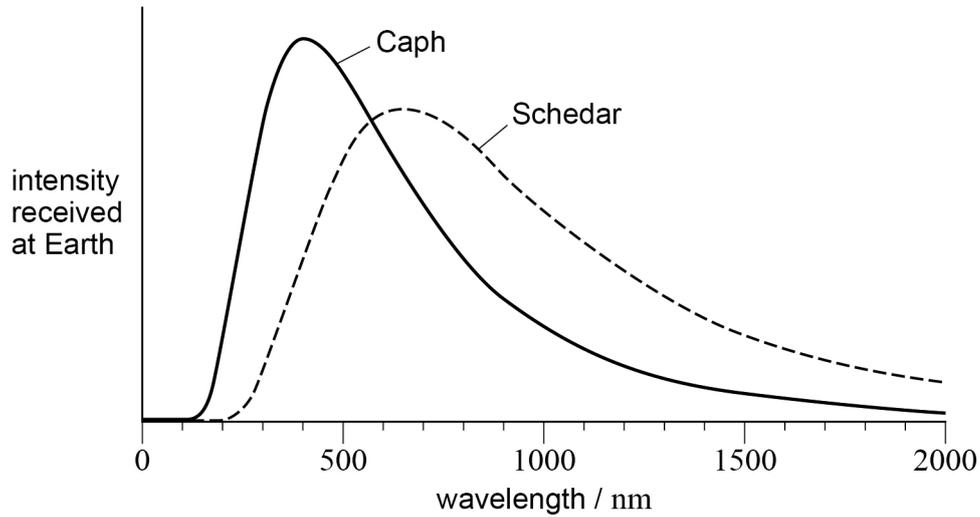


0 2 . 2

Figure 1 shows the intensity received at Earth from two of the stars, plotted against wavelength.

The effect of absorption by the Earth's atmosphere is not shown.

Figure 1



Discuss what information can be found from **Figure 1** about the temperature and colour of these stars.

Support your answer with suitable calculations.

[4 marks]

Question 2 continues on the next page

Turn over ►



0 2 . 3

State which star in **Table 1** is dimmest on the absolute magnitude scale.**[1 mark]**

0 2 . 4

Calculate the absolute magnitude of Schedar.

[3 marks]

absolute magnitude = _____

0 2 . 5

Tsih has a mass over 15 times the mass of the Sun.
Tsih may eventually collapse to form a black hole.

Calculate the radius of the event horizon for a black hole with a mass 15 times that of the Sun.

[2 marks]

radius = _____ m

11



0 3

Type 1a supernovae can be used as standard candles.

0 3 . 1

State what is meant by a standard candle.

[1 mark]

0 3 . 2Sketch on **Figure 2** the light curve for a type 1a supernova.
Annotate your graph with suitable scales and a unit for time.**[3 marks]****Figure 2**absolute
magnitude

time /

Question 3 continues on the next page**Turn over ►**

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outside the
box*

Turn over for the next question

10

Turn over ►



0 4

Table 2 gives data about the supergiant star Melnick 34 and the Sun.

Table 2

Name	Radius / m	Surface temperature / K
Melnick 34	1.4×10^{10}	53 000
Sun	7.0×10^8	5 700

0 4 . 1

Calculate $\frac{\text{power output of Melnick 34}}{\text{power output of the Sun}}$.

[2 marks]

answer = _____

0 4 . 2

Discuss why the evolution of a supergiant star in the local part of our galaxy could be dangerous for life on Earth.

[2 marks]

4

END OF QUESTIONS

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